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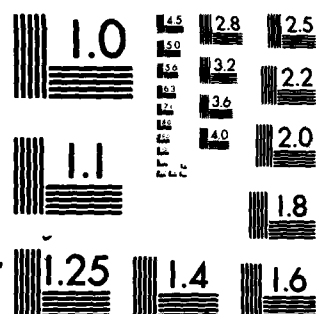
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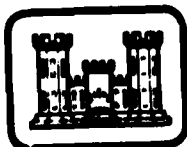
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**ROOFS IN COLD REGIONS: MARSON'S
STORE, CLAREMONT, NEW HAMPSHIRE**

Wayne Tobiasson and Charles Korhonen

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A reinforced, single-ply PVC membrane was examined five years after being applied over a leaky, built-up, bituminous membrane. The bare PVC membrane was dirty, poorly drained and littered with broken glass, nails and such, yet no flaws were evident or leaks reported. Even at 0°F the PVC was quite flexible. Diagonal wrinkles at a parapet wall were attributed to workmanship; other observations suggested that membrane shrinkage had not occurred. The membrane has functioned well for five years and appears to be in good condition.			

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PREFACE

This report was prepared by Wayne Tobiasson and Charles Korhonen, Research Civil Engineers, Civil Engineering Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory.

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B. Coutermarsh of CRREL and M. Rosenfield of CERL technically reviewed this report.

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ROOFS IN COLD REGIONS: MARSON'S STORE, CLAREMONT, NEW HAMPSHIRE

By Wayne Tobiasson and Charles Korhonen

INTRODUCTION

The waterproofing membrane on most relatively-flat roofs is constructed of alternating layers of bitumen-saturated felts and hot bitumen followed by a flood coat of hot bitumen. Gravel is often placed in the flood coat to act as a surfacing. However, single-ply membranes made of polymers such as polyvinyl chloride (PVC) or elastomers such as ethylene propylene diene monomer (EPDM) are growing in popularity.

Some of the early PVC membranes experienced embrittlement and shrinkage with age, but newer membranes formulated in different ways and reinforced with other materials offer promise of a significant reduction in these problems.

One such PVC membrane is sold by Sarnafil U.S. Inc. of Needham, Mass. Sarnafil-G material is 0.047 in. (1.2 mm) thick and contains a layer of non-woven fibrous glass reinforcing embedded in its center. It is produced in rolls 6½ ft (2 m) wide which can be either loose-laid on the roof and ballasted for wind resistance or attached to the roof. Attachment can be by overall adhesion or by mechanical fastening. The 6½ ft (2 m) wide sheets are lapped 3 in. (7.6 cm) and are sealed by hot air welding. The membrane is also hot-air welded to special metal flashing materials which are factory-coated with PVC.

Although this product has been used in Europe since the 1960's, it has been in use in the USA for only a few years. The oldest application of Sarnafil in the USA is on the roof of a small store in Claremont, New Hampshire. We examined that roof about five years after the PVC membrane was installed.

MARSON'S STORE

Marson's Army-Navy Department Store (Fig. 1) is located on Washington Street in Claremont. Mr. Martin Borofsky has owned and operated the store for some time. The old waterproofing consists of a conventional, hot-applied, built-up bituminous membrane. The roof deck is wood. No insulation or vapor retarder is present between the deck and the old membrane. Prior to 1975 roof leaks were a chronic problem. Mr. Borofsky made several attempts to solve them by overcoating the existing roof with cutback asphaltic coatings. He never succeeded in eliminating leaks using this approach and in 1975 decided to invest in a new membrane. A Sarnafil representative recommended that a layer of fiberboard be placed over the existing, essentially flat membrane and secured by mechanically fastening it into the wood deck below. The new PVC membrane would be fully adhered to the fiberboard with Sarnacol 2170 adhesive. The system was installed during a two to three week period in December of 1975.



Figure 1. Marson's store.

Since that time the roof has been trouble-free. Mr. Borofsky is quite pleased with the new product. He is understandably reluctant to disturb it, but was kind enough to let us examine it on 31 January 1980.

ROOF EXAMINATION

In Figure 1, it is evident that this one-story building abuts a three-story building. This is also shown in Figure 2 which was taken on the roof near the front of the store looking toward the rear. A few small vents on the roof, a chimney at the rear, and a roof-mounted air conditioner are also evident in Figure 2. The other end of the roof is shown in Figure 3.

The gray PVC membrane was rather dirty, as evidenced by the cleaned area in Figure 4. The mechanical fasteners used to attach the fiberboard to the deck and the seams between the fiberboards cause the membrane to accumulate dirt at different rates there. As a result, manifestations of these features are present (Fig. 5). Thermal weak links created by the fasteners were evident at the edge of the snow cover where the extra heat loss from the fasteners melted the snow directly above them (Fig. 6).

We examined the membrane in some detail, with attention to lap seams, flashings, and penetrations. Laps at seams are uniform at about 3 in. (8 cm) (Fig. 7). They are tight; no fishmouths were detected.

Flashings around penetrations such as plumbing vents (Fig. 8) and air exhaust-stacks (Fig. 9) were tight. Flashings at the chimney (Fig. 10), at the parapet near the front of the building (Fig. 11 and 12), and at the windows where the higher building abuts this roof (Fig. 13) were also secure.



Figure 2. Roof, looking toward rear of store.



Figure 3. Roof, looking toward front of store.



Figure 4. Dirt on the PVC membrane (also note nails).

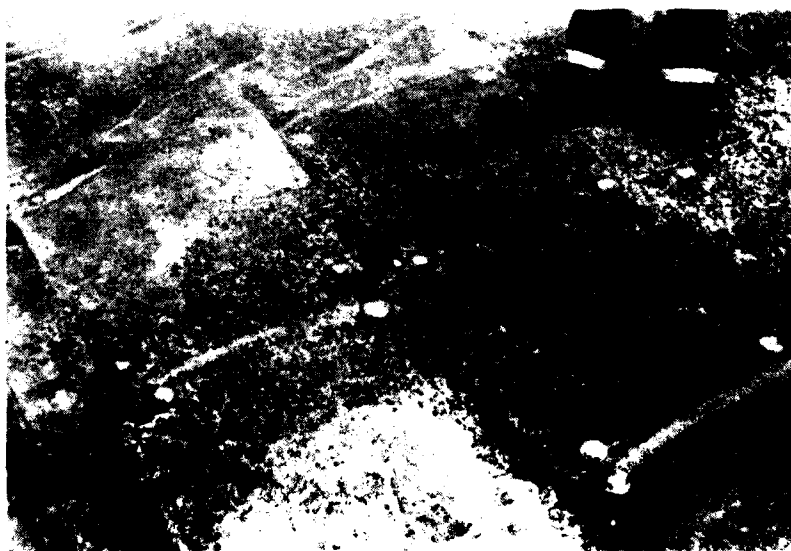


Figure 5. Dirt patterns reveal insulation board boundaries and mechanical fasteners.



Figure 6. Boundary of snow-covered area showing extra melt above mechanical fasteners.



Figure 7. Lap seam.



Figure 8. Tight flashing at plumbing vent (note crushed can on membrane).



Figure 9. Tight flashing at exhaust hood.



Figure 10. Chimney flashing detail.



Figure 11. Parapet at front corner of building (note diagonal wrinkles).



Figure 12. Detail of end of parapet shown in Figure 11.



Figure 13. Flashing details at windows (note poor condition of brickwork).

The PVC-coated metal fascia was nailed about 3-1/2 in. (9 cm) on center (Fig. 14) around the perimeter, which is slightly raised above the rest of the "dead-level" deck.

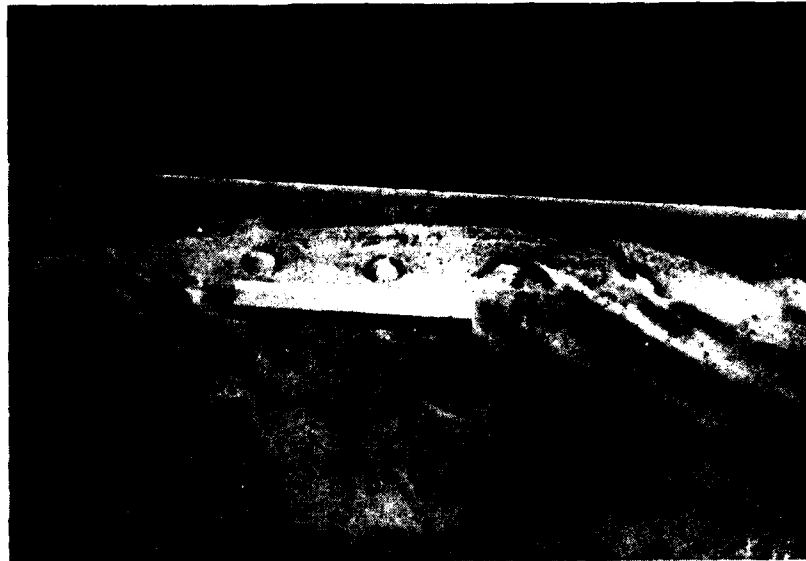


Figure 14. Perimeter nailing pattern (about 3-1/2 in. on center).

The fascia was neat and well secured. Seams in the metal were overlaid with a strip of membrane material (Fig. 15) which continued up over the edge and onto the roof membrane (Fig. 16) to strengthen the PVC there.

Roof drainage was provided by one scupper (Fig. 17) about half way back along the "free" side of the building. The downspout below the scupper is evident as a black vertical line in Figure 1. Scuppers are ill-suited for use in cold regions and this one was no exception. Although Figure 17 does not show it well, the passage into the scupper was blocked with debris. The dark area at the bottom of Figure 17 is ice, up to 1 in. (2.5 cm) thick. Even if no debris existed on this roof, some ponding would still occur since the scupper was not in the lowest area.

Snow and ice were evident on portions of the roof (Fig. 2 and 3). In places the depth of ice exceeded 1 in. (2.5 cm) and perhaps approached 2 in. (5 cm). It was about 0°F (-18°C) during our inspection, but the week prior to the inspection had been somewhat warmer. As the result of the recent cooling, several contraction cracks had developed in the ice cover prior to our visit (Fig. 18). None of these cracks appeared to have progressed through the membrane.

A second layer of PVC was placed on the roof before the air conditioner was positioned there on two planks (Fig. 19).



Figure 15. Fascia detail showing PVC cover over joint.

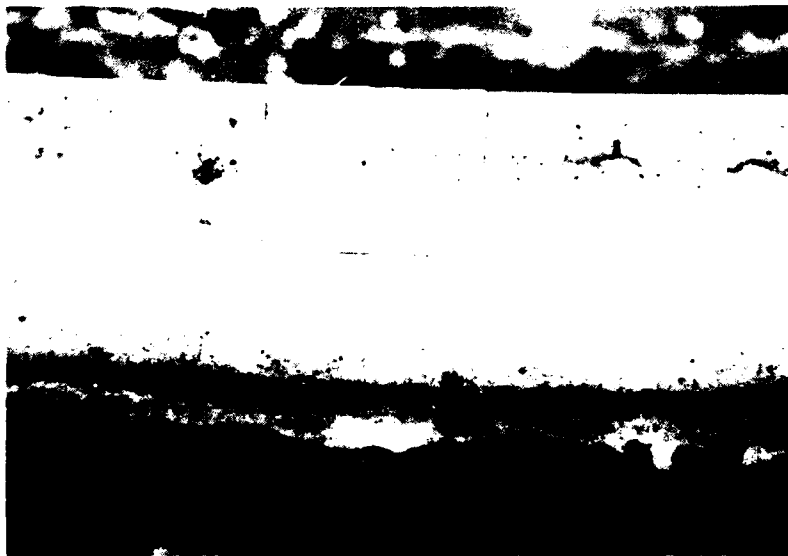


Figure 16. Looking down on raised edge of roof showing PVC cover over joint in fascia.



Figure 17. Scupper blocked with debris. Dark material in lower portion of photograph is ice.



Figure 18. Cracks in the ice cover.

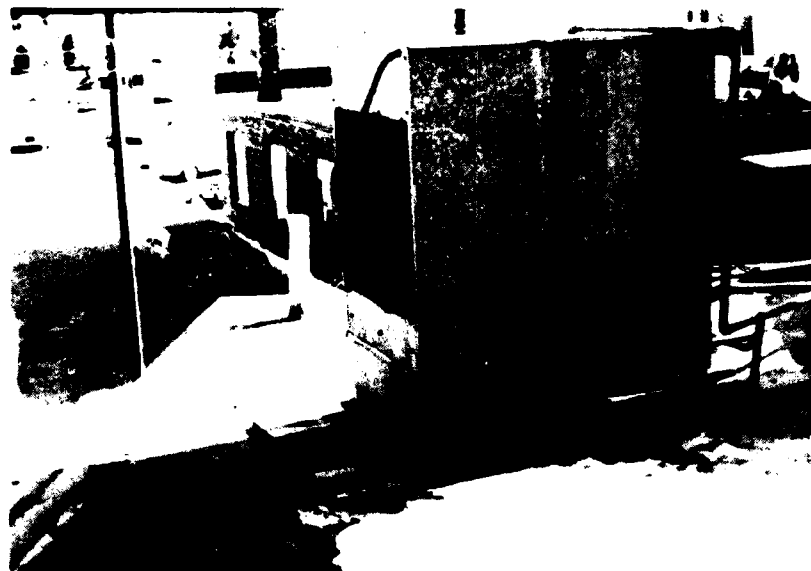


Figure 19. Air conditioner supported on planks.
Two layers of PVC are present in that area.

By pushing on the membrane where it was wrinkled we detected that it was quite flexible, even at 0°F (-18°C).

Diagonal wrinkles were the only visual sign of concern that we detected. They are evident in Figures 10-14 and suggest that some membrane shrinkage has occurred. However, the membrane had not pulled away from the vertical walls at any of these locations; we could push back against a solid object wherever we tried.

Consequently, we feel that the wrinkles do not indicate membrane shrinkage since construction. They were probably built into the membrane during installation. No matter what their source, the only adverse effect of the wrinkles appears to be aesthetic since the membrane has not pulled flashings away from the wall or, in any way that we could see, jeopardized the waterproofing integrity of the roof.

The driveway alongside this building (Fig. 1) is a convenient walkway and some people throw bottles and other objects up onto this roof. Several pieces of broken glass were observed along with cans (Fig. 8), nails (Fig. 4), old pipes and such. The bare PVC membrane appears to have survived this abuse but we recommended to Mr. Borofsky that he clear the debris from the roof and check the membrane for cuts next spring. We also suggested that a strainer be placed at the scupper and that methods such as solar-powered siphons be investigated to remove ponded water.

CONCLUSIONS

The 5-year-old PVC membrane on this roof is quite flexible and appears to be functioning well. Flashings and penetrations appear in excellent condition. Diagonal wrinkles are present but other evidence suggests that they were built into the membrane rather than the result of membrane shrinkage. The PVC membrane has maintained its waterproofing integrity for five years.